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United States Patent [19]

Silverbrook et al.

[11] **Patent Number:** 6,137,500[45] **Date of Patent:** Oct. 24, 2000[54] **UTILIZING OF BRUSH STROKING TECHNIQUES IN THE GENERATION OF COMPUTER IMAGES**[75] Inventors: **Kla Silverbrook; Paul Lapstun**, both of Sydney, Australia[73] Assignee: **Silverbrook Research Pty Ltd**, Balmain, Australia[21] Appl. No.: **09/112,797**[22] Filed: **Jul. 10, 1998**[30] **Foreign Application Priority Data**

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[51] Int. Cl.⁷ G06F 15/00

[52] U.S. Cl. 345/442

[58] Field of Search 345/440, 441, 345/442, 443, 118, 121

[56] **References Cited****U.S. PATENT DOCUMENTS**

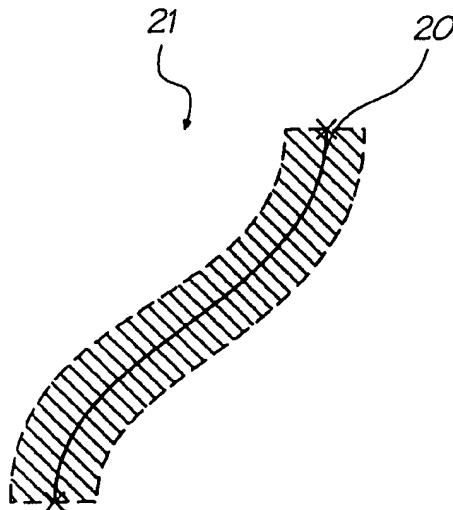
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Primary Examiner—Phu Nguyen

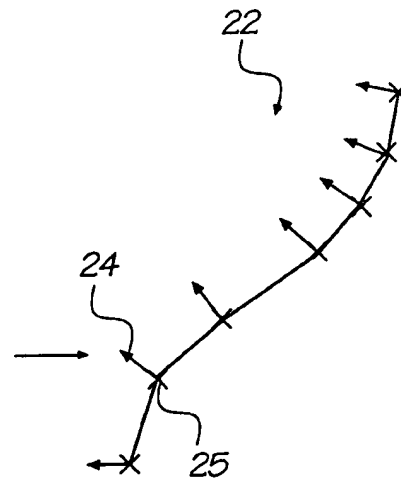
[57] **ABSTRACT**

A form of "brushing" an computer graphic image is disclosed. The method includes brushing a simulated brush stroke along a path in a computer graphics image by converting the path to a series of corresponding line segments; determining a current convex brush edge of the path; determining a series of substantially equally spaced points along the convex edge; determining corresponding parametric points along the path; and utilising the parametric points to place brush template structures in the computer graphics image. In a first refinement, the opacity channel is combined such that the maximum of a current brush template opacity value and a current computer graphic image opacity channel value becomes the new current computer graphic image opacity channel value. In a second refinement, the opacity channel is combined such that the minimum of a current brush template opacity value and a current computer graphic image opacity channel value becomes the new current computer graphic image opacity channel value. In a third refinement, the computer graphic image further comprises a footprint channel which is set when each pixel is composited and the opacity channel is only composited with the computer graphic image opacity channel when the footprint channel is not set.

6 Claims, 4 Drawing Sheets



BEZIER



PIECEWISE LINE SEGMENTS

INK TYPE				
	Description	Advantages	Disadvantages	Examples
Aqueous, dye	Water based ink which typically contains: water, dye, surfactant, humectant, and biocide. Modern ink dyes have high water-fastness, light fastness	<ul style="list-style-type: none"> Environmentally friendly No odor 	<ul style="list-style-type: none"> Slow drying Corrosive Bleeds on paper May strikethrough Cockles paper 	<ul style="list-style-type: none"> Most existing inkjets All IJ series ink jets Silverbrook, EP 0771 658 A2 and related patent applications
Aqueous, pigment	Water based ink which typically contains: water, pigment, surfactant, humectant, and biocide. Pigments have an advantage in reduced bleed, wicking and strikethrough.	<ul style="list-style-type: none"> Environmentally friendly No odor Reduced bleed Reduced wicking Reduced strikethrough 	<ul style="list-style-type: none"> Slow drying Corrosive Pigment may clog nozzles Pigment may clog actuator mechanisms Cockles paper 	<ul style="list-style-type: none"> IJ02, IJ04, IJ21, IJ26 IJ27, IJ30 Silverbrook EP 0771 658 A2 and related patent applications Piezoelectric ink-jets Thermal ink jets (with significant restrictions)
Methyl Ethyl Ketone (MEK)	MEK is a highly volatile solvent used for industrial printing on difficult surfaces such as aluminum cans.	<ul style="list-style-type: none"> Very fast drying Prints on various substrates such as metals and plastics 	<ul style="list-style-type: none"> Odorous Flammable 	<ul style="list-style-type: none"> All IJ series ink jets
Alcohol (ethanol, 2-butanol, and others)	Alcohol based inks can be used where the printer must operate at temperatures below the freezing point of water. An example of this is in-camera consumer photographic printing.	<ul style="list-style-type: none"> Fast drying Operates at sub-freezing temperatures Reduced paper cockle Low cost 	<ul style="list-style-type: none"> Slight odor Flammable 	<ul style="list-style-type: none"> All IJ series ink jets
Phase change (hot melt)	The ink is solid at room temperature, and is melted in the print head before jetting. Hot melt inks are usually wax based, with a melting point around 80° C. After jetting the ink freezes almost instantly upon contacting the print medium or a transfer roller.	<ul style="list-style-type: none"> No drying time- ink instantly freezes on the print medium Almost any print medium can be used No paper cockle occurs No wicking occurs No bleed occurs No strikethrough occurs 	<ul style="list-style-type: none"> High viscosity Printed ink typically has a 'waxy' feel Printed pages may 'block' Ink temperature may be above the curie point of permanent magnets Ink heaters consume power Long warm-up time 	<ul style="list-style-type: none"> Tektronix hot melt piezoelectric ink jets 1989 Nowak U.S. Pat. No. 4,820,346 All IJ series ink jets
Oil	Oil based inks are extensively used in offset printing. They have advantages in improved characteristics on paper (especially no wicking or cockle). Oil soluble dyes and pigments are required.	<ul style="list-style-type: none"> High solubility medium for some dyes Does not cockle paper Does not wick through paper 	<ul style="list-style-type: none"> High viscosity: this is a significant limitation for use in inkjets, which usually require a low viscosity. Some short chain and multi-branched oils have a sufficiently low viscosity. Slow drying Viscosity higher than water Cost is slightly higher than water based ink High surfactant concentration required (around 5%) 	<ul style="list-style-type: none"> All IJ series ink jets
Micro-emulsion	A microemulsion is a stable, self forming emulsion of oil, water, and surfactant. The characteristic drop size is less than 100 nm, and is determined by the preferred curvature of the surfactant.	<ul style="list-style-type: none"> Stops ink bleed High dye solubility Water, oil, and amphiphilic soluble dyes can be used Can stabilize pigment suspensions 		<ul style="list-style-type: none"> All IJ series ink jets

We claim:

1. A method of brushing a simulated brush stroke along a path in a computer graphics image said method comprising the steps of:

- converting the path to a series of corresponding line segments;
- determining a current convex brush edge of said path;
- determining a series of substantially equally spaced points along said convex edge;
- determining corresponding parametric points along said path; and
- utilising said parametric points to place brush template structures in said computer graphics image.

2. A method as claimed in claim 1 wherein said brush template structures includes an opacity channel which is combined with the opacity channel of the computer graphic image.

3. A method as claimed in claim 2 wherein said opacity channel is combined such that the maximum of a current

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brush template opacity value and a current computer graphic image opacity channel value becomes the new current computer graphic image opacity channel value.

4. A method as claimed in claim 2 wherein said opacity channel is combined such that the minimum of a current brush template opacity value and a current computer graphic image opacity channel value becomes the new current computer graphic image opacity channel value.

5. A method as claimed in claim 2 wherein said computer graphic image further comprises a footprint channel which is set when each pixel is composited and said opacity channel is only composited with the computer graphic image opacity channel when said footprint channel is not set.

6. A method as claimed in claim 1 wherein said computer graphic image comprises a brushing buffer which is subsequently combined with a second computer graphic image so as to form a final computer graphics image.

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